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विशिष्ट गैसों के प्रहस्तन की रीति संहिता

Indian Standard

CODE OF PRACTICE FOR HANDLING OF SPECIALITY GASES

UDC 661.91 : 614.878

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

July 1992

Price Group 3

Industrial Gases Sectional Committee, CHD 006

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Industrial Gases Sectional Committee had been approved by the Chemical Division Council.

It is not possible to determine the purity of such gases and their mixtures by means of usual techniques of chemical analysis. Special instruments are, indeed, required to ascertain the purity which is usually expressed in parts per million (ppm) or parts per million volumes (vpm) Usually, minute traces of oxygen, moisture, hydrocarbons, carbon dioxide, carbon monoxide, etc, are the impurities present which have to be determined separately in a major component.

Traces of oxygen can be analysed by fuel cell or zirconium based oxygen monitors. For moisture measurement, aluminium oxide based monitor, infra-red analysers, electronic or capacitive sensors may be used. For determination of traces of carbon dioxide and carbon monoxide at ppm level, gas chromatography is used. Thermal conductivity detector or flame ionization detector gas chromatograph can be used for the analysis of hydrocarbons. In addition, there are detectors available for measuring hydrogen sulphide, nitric oxide, sulphur dioxide, chlorine, etc, present in minute traces.

For certain critical applications, it is not sufficient to know only the purity but it is also necessary to determine what the balance impurities are. This makes it necessary to know certain basic features in order to handle speciality gases safely as given below:

a) The physical and chemical properties of the gas mixture being handled,

b) The necessary general precautions to be taken in the use of speciality gases and additional precautions specific to the gases or mixtures, and

c) The hazards associated with the gases or mixtures and the necessary emergency first-aid.

This Indian Standard has been formulated with a view to prescribe the basic guidelines for the handling of speciality/electronic gases and their mixtures.

AMENDMENT NO. 1 FEBRUARY 2006
TO
IS 13490 : 1992 CODE OF PRACTICE FOR HANDLING OF SPECIALITY GASES

[*Page* 3 *clause* **3.2** (aa)] — Add the following at the end:

'ab) Cylinders should be fitted with appropriate valves suitable for the gas mixture.'

[*Page* 3 *clause* **3.3** (j) — Add the following at the end:

'k) The system for controlling the storage and movement of highly toxic gases shall be audited regularly to ensure its safe operation.'

[*Page* 4 *clause* **4.3** , *last line*] — Substitute '2004' *for* '1981'.

(CHD 6)

Reprography Unit, BIS, New Delhi, India

Indian Standard

CODE OF PRACTICE FOR HANDLING OF SPECIALITY GASES

1 SCOPE

This Indian Standard prescribes code of practice for handling of speciality gases.

2 CLASSIFICATIONS

Gaseous and liquefied compressed gases may be classified according to the nature of hazard as specified in **2.1** to **2.9**.

2.1 Flammable Gas

Flammable gas, when mixed with air, oxygen or other oxidants burns or explodes upon ignition depending upon the degree of confinement. Every flammable gas has a gas-in-oxidant concentration range within the limits of which the gas may be ignited. Flammable ranges are expressed in terms of air at ambient temperature and atmospheric pressure. A change in temperature, pressure or oxidant concentration may vary the flammable range considerably. Mixtures above and below the flammable range do not ignite. As a precaution in handling flammable gases, care must be taken to eliminate all possible sources of ignition through proper design installation of approved electrical systems and restriction of smoking and use of open flames, fires or welding. An explosive meter or similar devices may be used to determine the existence of a flammable mixture in area of suspected leakages.

2.2 Oxidant

A number of gases, although non-flammable, may initiate and support combustion. Materials that burn in air, burn more vigorously and/or explosively in oxygen and certain other oxidants. All possible sources of ignition must be eliminated while handling oxidants. Oxidants must not be stored with combustible materials. Oils, greases or other combustible substances must not come in contact with cylinders or equipment used in oxidant service.

2.3 Corrosive Gas

Corrosive gas is a gas that corrodes and erodes materials with which they come in contact, such as metals, fabrics, human tissue, etc. Some gases, though not corrosive in their anhydrous form, become corrosive in the presence of moisture. Special care must be taken when selecting the proper construction material for equipment in which corrosive gas is handled.

2.4 Irritant Gas

The gases that cause inflammatory reactions after immediate, prolonged or repeated contact are sometimes called irritant gases. Protective clothing and equipment must be used to minimize exposure to corrosive or irritant gases.

2.5 Pyrophoric Gas

Flammable gas which burns spontaneously upon exposure to air is called pyrophoric gas.

2.6 Inert/Asphyxiant Gas

Gases which do not react with other materials under the normal conditions of temperature and pressure are classified as inert. If released in a confined area, these gases may displace oxygen content of the air below the level necessary to sustain life. Therefore, adequate ventilation and monitoring of the oxygen content of confined areas should be carried out to minimize this possibility.

2.7 Anesthetic Gas

A gas which, when inhaled, causes loss of consciousness without other sysmptoms is called anesthetic gas.

2.8 High Pressure Gas

Though not an inherent property of any gas, as most speciality gases are compressed to pressures up to 150 mm Hg or more, a sudden release of pressure may cause serious damage to personnel or equipment by propelling a cylinder or whipping a line. Factors that are to be considered while choosing construction materials and designing gas-handling systems are temperature and pressure of the gas, and the possibility of pressure build-up in the system.

2.9 Cryogenic Gas

Gases having very low boiling points are stored as liquids in insulated vacuum jacketed dewars or insulated pressurised cylinders. Contact with these liquids causes burning due to the freezing of skin tissue by the rapidly evaporating liquid. Also, the liquid produces a large volume of gas upon vaporization in inadequately ventilated areas, except in the case of oxygen. This may decrease the oxygen content of the air below the level necessary to sustain life. Adequate ventilation, monitoring of oxygen content of confined areas and use of protective clothing minimize the hazards.

3 SAFETY

Following general practices are recommended for the safe handling and storage of both high pressure and liquefied compressed gases. Additional precautions may be necessary depending upon the category of gas (corrosive, anaesthetic, flammable, pyrophoric oxidant, irritant, cryogenic or inert), individual property of the gas and the process in which it is used.

3.1 General

Following general precautions should be exercised before handling speciality gases:

a) Only experienced and properly trained personnels should handle speciality gases,

b) All regulations and local requirements regarding storage of cylinders should be strictly followed,

c) Labels provided by the supplier for identification of cylinder content should not be removed or defaced,

d) Ascertain the identity of the gas before use,

e) The properties and hazards associated with each gas should be thoroughly studied and understood before use,

f) Before using compressed gases, establish plans to cover any emergency situation that might arise, and

g) When doubt arises on correct handling procedure for a particular gas, approach the supplier.

3.2 Handling and Use

3.2.1 Following general precautions should be exercised in handling of speciality gases;

a) Wear stout gloves,

b) Do not lift a cylinder by the cap or guard;

c) Use cylinder trolley or other suitable device for transporting cylinders even for a short distance;

d) Leave valve protection caps/guards in place until the cylinder has been secured against either a wall or bench or placed in a cylinder stand and is ready for use;

e) Wear suitable eye and face protection. The choice between safety glasses and chemical goggles, or full shield will depend upon the pressure and nature of the gas being used;

f) Where necessary, for example for toxic gases, ensure that a self-contained positive pressure breathing apparatus or a full face air line respirator is available in the vicinity of the working area;

g) Check for gas leaks using soapy water. When gas is flammable, check with soapy water or an approved explosivemeter. When a gas is toxic, check special procedures specified by the supplier;

h) Ascertain that an adequate supply of water is available for first-aid, fire fighting, or dilution of corrosive material in the event of leakage;

j) Employ suitable pressure regulating devices on all cylinders when the gas is being emitted to systems with a lower pressure rating than that of the cylinder;

k) Before connecting cylinder for use ensure that back-feed from the system into the cylinder is prevented;

m) Before connecting the cylinder, check the complete gas system for suitability particularly for pressure rating and materials;

n) Do not permit liquefied gas to become trapped in parts of the system as this may result in hydraulic rupture;

p) Ascertain that all electrical systems in the area are suitable for service with the gas;

q) Do not use direct flame or electrical heating device to raise the pressure of a cylinder. Cylinders should not be subjected to temperatures above 45 °C;

r) Do not recompress a gas or a gas mixture from a cylinder and do not attempt to transfer gases from one cylinder to another without consulting the supplier;

s) Do not attempt to increase liquid draw-off rate by pressuring the cylinder without first checking with the supplier;

t) Do not use cylinders and rollers or supports, or for any other purpose than to contain gas as supplied;

u) Do not permit oil, grease or other readily combustible substances to come in contact with valves of cylinder, oxygen or other oxidants;

v) Keep the cylinder valve outlets clean and free from contaminants, particularly oil and water;

w) Do not subiect cylinder to abnormal mechanical shocks which may cause damage to valves or safety devices;

y) Do not attempt to repair or modify cylinder valves or safety relief devices. Damaged valves shall be reported immediately to the supplier;

z) Close the cylinder valve whenever gas is not required even if cylinder is still connected to equipment; and

aa) Replace outlet cap or plug and cylinder cap as soon as cylinder is disconnected from equipment.

3.2.2 Certain gas mixtures have a tendency to stratify. Such cylinders can be kept horizontally one day before and rolled over several times on a smooth floor before use. This will ensure thorough mixing.

3.3 Storage

Following general precautions should be exercised in storage of specially gases:

a) Cylinders shall be stored in a purpose-built compound which shall be well ventilated, preferably in the open shed, at a location free from fire risk and away from sources of heat and ignition and the area shall be kept clean and access shall be restricted to authorised persons only. The area shall be clearly marked as a cylinder store and appropriate hazard warning signs displayed, for example, flammable, toxic, etc;

b) Smoking and the use of naked flames and welding, either inside or in the vicinity of the cylinder storage area shall be prohibited;

c) Cylinders shall be stored in the vertical position and properly secured to prevent toppling. The cylinder valves shall be tightly closed and appropriate valve outlets shall be capped or plugged. Cylinder valve guards or caps shall also be properly secured;

d) Cylinders stored in the open shed shall be protected from rusting and extreme weather. It is advisable to keep cylinders on open galvanized steel grid work to prevent corrosion of the cylinder base;

e) Empty cylinders shall be stored separately;

f) Gas cylinders shall be segregated in the storage area according to various categories, that is, toxic, flammable, etc; and cylinders containing oxygen and oxidants should be separated from flammable gases by a fire resistant partition;

g) Only minimum number of cylinders containing flammable or toxic gases shall be kept in the store and cylinders held in storage shall be periodically checked for general condition and leakage;

h) Cylinders containing flammable gases shall be stored away from other combustible materials; and

j) Before entering a storage area containing flammable or toxic gases, ascertain whether flammable or toxic materials are present in the atmosphere.

4 HANDLING AND STORAGE OF SPECIALITY GASES

4.1 General

Recommended procedures are based on the need to handle extremely toxic and in some cases highly corrosive and pyrophoric gases whilst maintaining impurity levels at the absolute minimum.

4.2 Safety Precaution for Speciality Gases

4.2.1 While handling speciality gases, particularly arsine and phosphine, it is necessary to take extra precautions over and above those normally exercised in the industrial gases industry. Some of the more important precautions are given below:

a) Keep positive pressure breathing apparatus near all work points and ensure that staffs are trained for its use;

b) Check that all regulators and equipment can sustain full cylinder pressure which may in certain cases be above 150 mm Hg;

c) All lines shall be checked for leakproof before use and ensure that all system components can withstand the proposed working pressure. For maintenance of purity, it is important to use either a non-ionic leak detection fluid, or a non-contaminant gas (helium) or an electronic or mass spectrometric leak detection;

d) Local hospitals and fire brigades shall be fully equipped for handling any emergency situation and the persons handling the gases shall be educated with regard to first-aid;

e) The person engaged in the handling of toxic or corrosive gases shall be competent and shall have experience on less hazardous gases;

f) Wear stout clothings, gloves and suitable face protection (safety glasses or full face shields);

g) Care must be taken while selecting materials of construction for fume cabinets and ventilation ducts, avoid use of flammable materials; and

h) En sure cylinders are safe after use. On return to supplier, cyliner valves must be checked for leak proofness and the protective valve cap secured.

4.2.2 Most leaks occur at the valve in the top of the cylinder. Areas that may be involved are:

a) Valve threads,

b) Safety devices,

c) Valve stem, and

d) Valve outlet.

If a leak develops, follow emergency action procedures and notify the supplier. Do not attempt to repair a leak at the valve threads of safety device. Consult the supplier for instructions if the leak is located at the valve stem or valve outlet. The following general procedures are for the leak of minimum size where the indicated action can be taken without serious exposure to personnel:

a) If a leak develops in a cylinder containing flammables, inerts or oxidants, ensure that there is adequate ventilation to dissipate the gas. Move the cylinder to an isolated area (away from combustible materials if the cylinder contains a flammable or oxidising gas) and post signs that describe the hazards and state warnings;

b) Some corrosives are also flammable or oxidizing, adding to the seriousness of the teak. If the product is Corrosive the leak may increase in size as the gas is released. Move the cylinder to an isolated and well ventilated area and use the neutralising scrubber or ducting away facility, usually avoidable with electronic gas users. Post signs that describe the hazard and state warning;

c) Follow the same procedure for toxic gases as for corrosive gases;

d) When the nature of the leaking product or the size of the leak constitute a hazard, wear self-contained breathing apparatus and protective clothing. Basic action for large or uncontrollable leaks should include the following steps:

    1) Evacuation of personnel,

    2) Rescue of injured personnel by crews equipped with adequate clothings and breathing apparatus,

    3) Fire fighting action,

    4) Emergency repairs/action,

    5) Decontamination, and

    6) *First-aid measures* — For corrosive gases flush the affected part with copious quantities of water. For toxic gases, remove the victim to fresh air. Keep the person warm and quiet. If necessary, give artificial respiration. Always call for a physician. In case of 'burn' caused by liquid gas, flush the affected part gently with tepid water.

4.3 Transport of Cylinders

Speciality gas cylinders should, preferably, be transported after creating and fixing dangerous goods label and name of the gas, and in accordance with provisions of *Gas Cylinder Rules,* 1981.

5 MAINTENANCE OF PURITY

In order to conform to the users demand for high final yields, the speciality gases are purified to higher levels than any other gas available today. In certain cases, impurity levels are one part in 10^{10} to 10^{12} parts. It is imperative that all precautions are to be taken to maintain the purity. Some of the most important ones include:

a) In new systems, check that all traces of flux are removed before use,

b) Ensure that jointing compounds have not been used,

c) Use stainless steel or monel gas lines from supply source to usage point,

d) Take care with choice of filters in the lines to prevent contamination of the gases;

e) Ensure that full evacuation and purge sequences are carried out before any line is used;

f) If leak testing with positive pressure and soapy water is carried out, ensure that a non-ionic surfactant solution is used;

g) Clean and degrease any surface after contact with operators hands;

h) Use a clean, lint free cloth to wipe connections and purge with high purity nitrogen;

j) All purging must be carried out using high purity gases (O_2 1 vpm, H_2O 1 vpm, HC 1 vpm) from a cylinder supply to prevent any possibility of contamination of a bulk supply source. The most effective means of purging is alternate pressurisation and evacuation. However, care must be taken to prevent back streaming of hydrocarbons from any pumps;

k) Ensure that the equipment used for any one of the active gases is thereafter dedicated to the service of that gas only and any equipment used, does not allow diffusion of impurities. Metal diaphragms shall be used on all regulators and regulators shall have facility for purging. Only recommended regulators given in suppliers gas data sheet shall be used;

m) Care shall be taken that all equipment can withstand the corrosive effects of these gases; and

n) Cylinders which are used for speciality gas service should preferably be brand new, as cylinder walls tend to adsorb gases. If a cylinder is previously filled with any other gas, then subsequent change of gas will have the risk of dilution of purity due to desorption of the previous gas from inside walls of cylinders, the internal walls may have to be specially prepared for speciality gases. Use of aluminium and stainless steel cylinder for speciality gases is increasing of late.

6 LABELING

6.1 Identification of contents by colour coding alone is difficult while dealing with a large number of gases and mixtures and it is best to stencil the full name of the gas on the cylinder. Where the size of cylinder is small and stenciling is not possible, a stout label with the name of the gas should be so fixed that it is not detached in normal transport and handling.

6.2 Besides usual procedures like indication of source of munufacture, despatch instructions, batch number, date of manufacture, etc, following additional information should also be given in the case of speciality gases:

a) *Name of the gas* — The full name and chemical symbols of the gas shall be written.

b) *Purity grade* — This shall be written as percent, ppm or vpm.

For information:

1 vpm = 0.0001 percent
100 vpm = 0.01 percent
10 000 vpm = 1.0 percent

7 ORDERING PROCEDURE

Following general instructions may be followed before placing orders for procurement of speciality gases:

7.1 Indicate whether a certificate of purity is required or not. It may sometimes be necessary to know what the balance impurities are. A certificate for impurities may also be given at some extra cost.

7.2 In case of mixture, the customer shall specify whether the different constituent gases are in approximate or exact proportion. In most applications exact proportions are not required but where required, extra cost is justified. It will also help supplier if an indication about the application is given.

7.3 While ordering, minimum quantity compatible with requirement and replenishment delays, may be ordered. The customer shall preferably, obtain the suppliers catalogue and shall specify the quantity and number of cylinders required. Small cylinders are handy for laboratory and in places, where large cylinders can not be handled. The customer should ask for all relevant information about the gases and mixtures being ordered, particularly safety leaflets and first-aid information as well as threshold limit valves (TLV) for continuous use.

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Doc : No. CHD 006 (0142)

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Printed at Printwell Printers, Aligarh, India